



# ENHANCING PROPERTIES OF OILPALM STEM PLYWOOD THROUGH PRE- TREATMENT OF PHENOLIC RESIN

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With Knowledge V



# INTRODUCTION



**Rapid growth of oil palm  
Plantation in Malaysia.  
1990 (1.7 MILLION ha)  
2006 (4.5 MILLION ha)**



- 100,000 hectares + 13.6 million OPS due to replanting each year (Anon 2005)
- Total 4.5 million m<sup>3</sup> plywood can be produce

# INTRODUCTION



- Based on 13.6 MILLION stems, about 4.5 million m<sup>3</sup> of OPS plywood can be produced each year.
- Taking the selling price of OPS plywood at RM1,000/m<sup>3</sup>, this would generate a revenue of RM4.5 billion to the plywood industry.
- If the QUALITY can improved, the price can be doubled, the revenue from palm plywood will reach RM 4.5 billion/year
- Export market: United States, United Kingdom, and Japan Due to its environment friendliness, lightness, and easy to work with.
- International acceptance: Certified as GREEN PRODUCT if the use of non-wood material > 10% - under sustainable forest resources

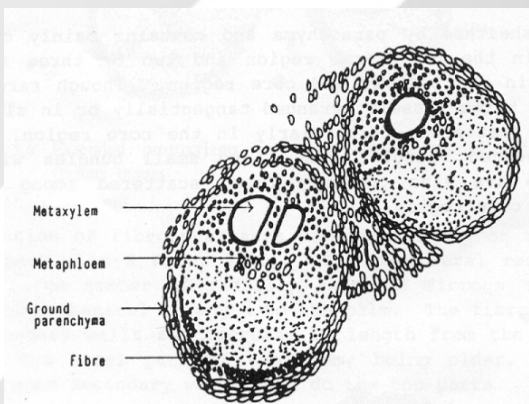
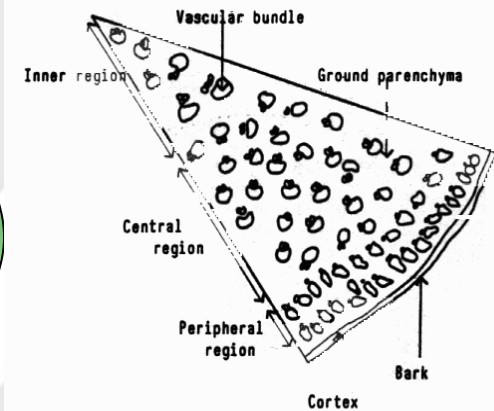


# COMMON PROBLEMS IN THE MANUFACTURE OF OIL PALM STEM PLYWOOD

## 1. Low Quality Veneer

- Contain two distinctly different materials: solid vascular bundle and loose parenchyma cells
- Rough surface
- Less stable (shrink and swell more)

- high adhesive consumption
- Use as core veneers



# COMMON PROBLEMS IN THE MANUFACTURE OF OIL PALM STEM PLYWOOD

## 2. Low Price Palm Plywood

- Low strength OPS plywood
- Low dimensional stability

- Low-grade Palm Plywood
- Categorised under Utility-Grade
- Current market price USD260/m<sup>3</sup>

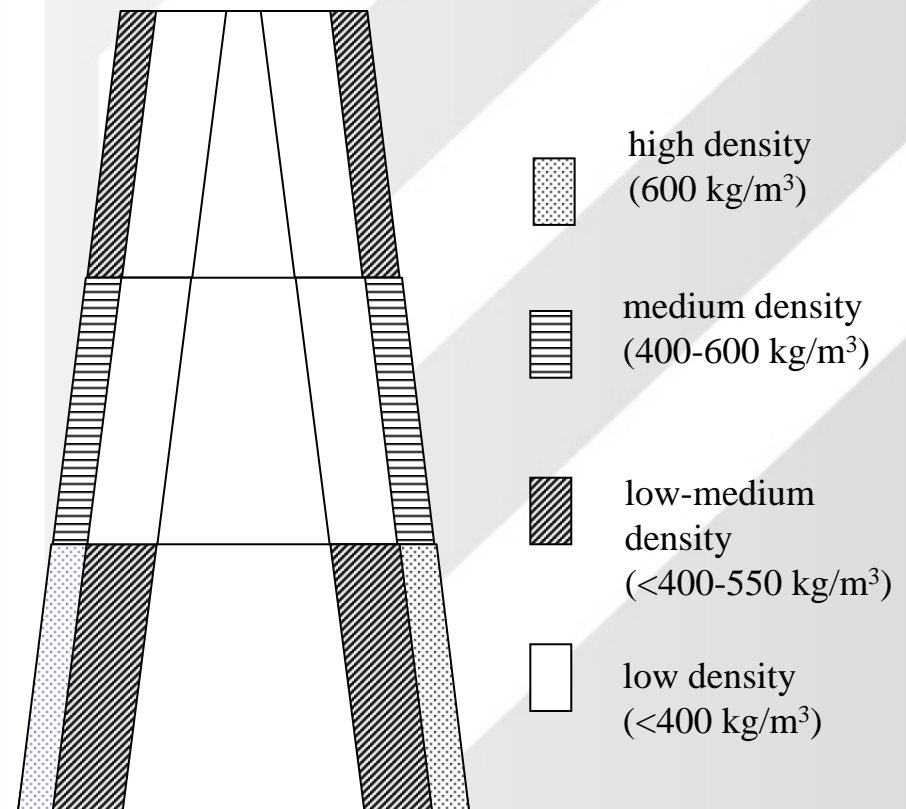


# COMMON PROBLEMS IN THE MANUFACTURE OF OIL PALM STEM PLYWOOD

## 3. Variation of density

Unevenly distribution of vascular bundles along the radial direction of stem - variation of density values at different parts of the oil palm stem.

Wide range density of oil palm veneers - affect the performance of Plywood



# OBJECTIVES

## Enhancement of veneer quality through resin treatment

- To develop effective resin treatment to improve the quality of OPS veneers
- To determine suitable adhesive spread rate for oil palm stem veneers
- To determine the mechanical properties of pre-treated OPS plywood

# Materials

OPS veneer : Outer layer (1<sup>st</sup> stage peeling, 358 - 442kg/m<sup>3</sup>)  
Inner layer (2<sup>nd</sup> stage peeling, 272 - 446kg/m<sup>3</sup>)

Treatment resin : Low Molecular weight Phenol  
Formaldehyde

Binder : Urea Formaldehyde



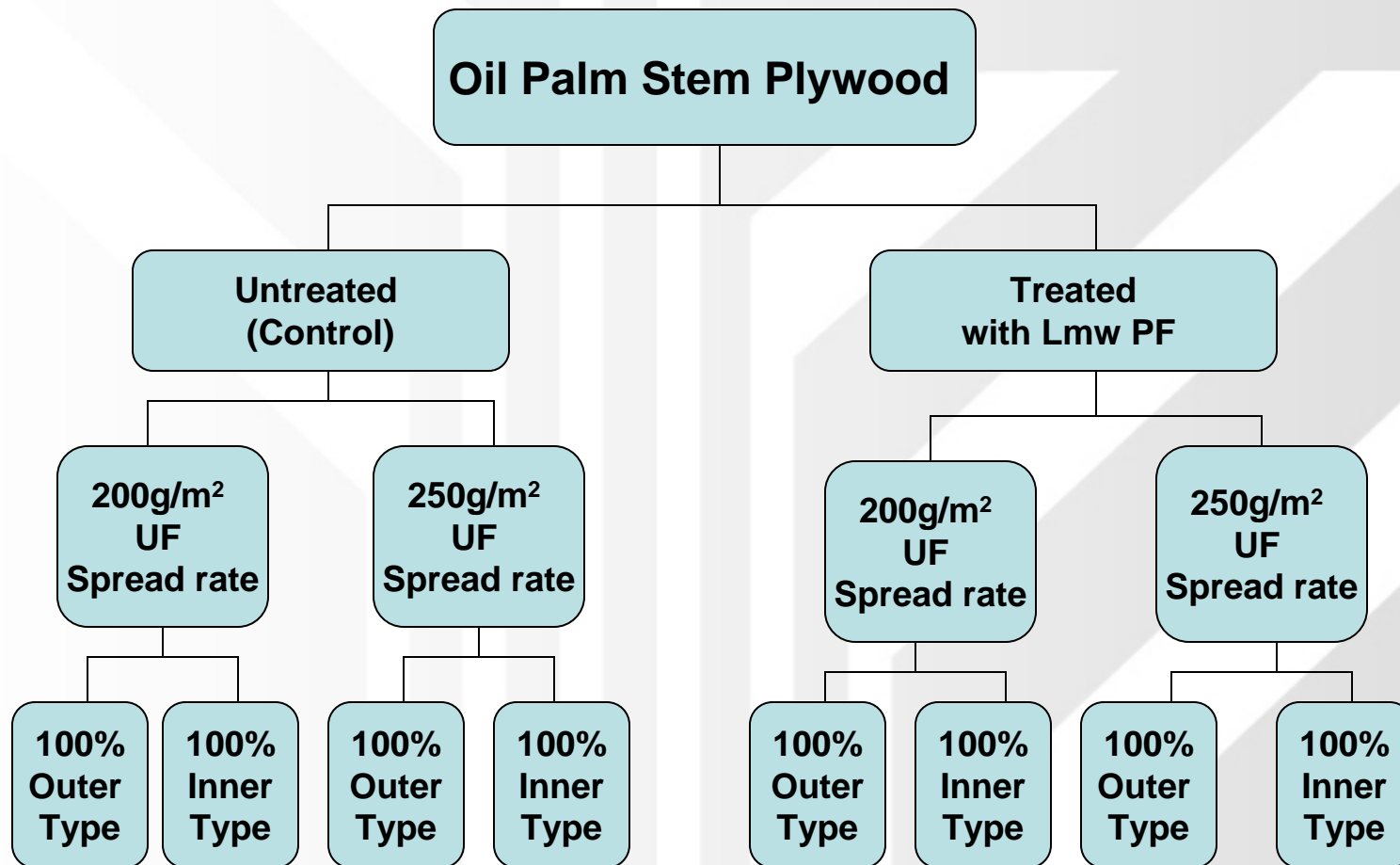




# METHODOLOGY

- **Phase 1: Oil Palm Trunk Veneer Production**
- **Phase 2: Pre-treatment of OPT veneer using PF resin.**
- **Phase 3: Production of Plywood**

# Parameter Used In This Study

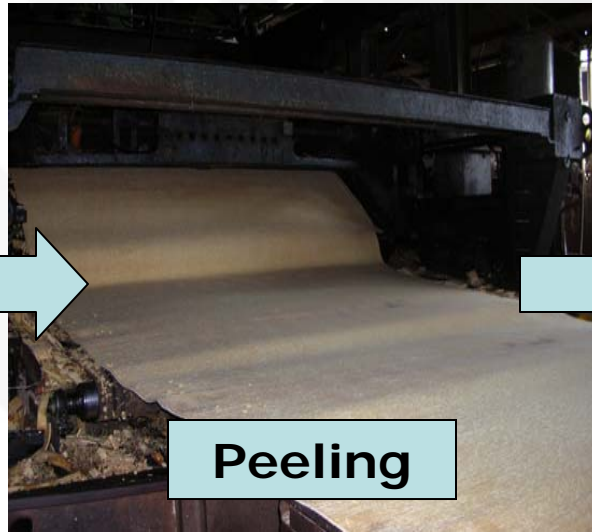


# Phase 1: Veneer Production

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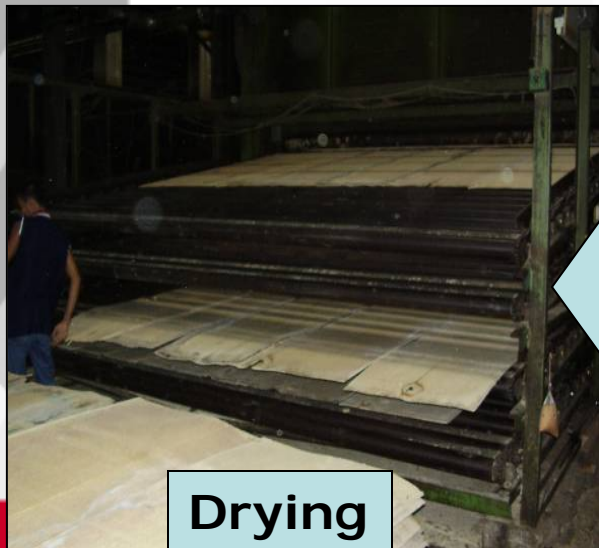
Log cutting



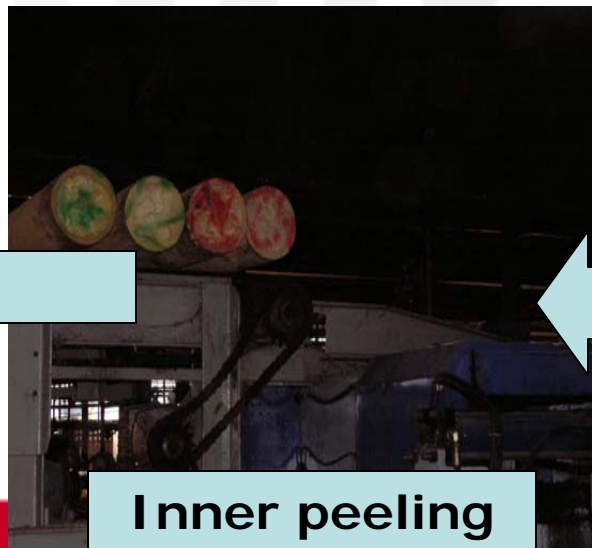
Peeling



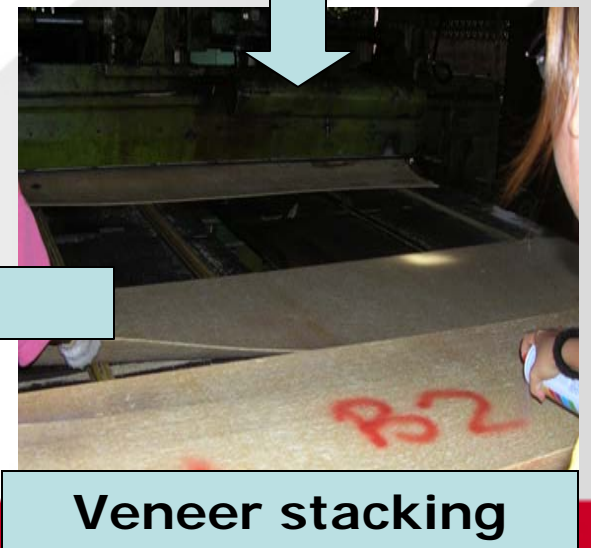
Clipping



Drying



Inner peeling



Veneer stacking

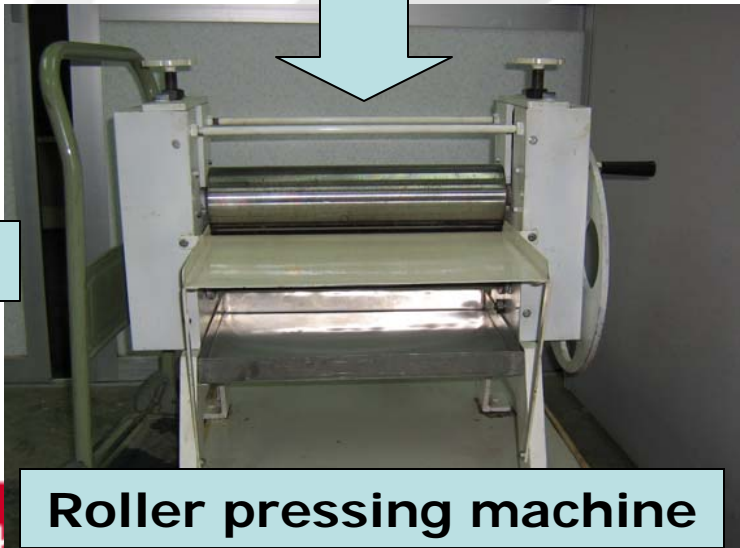
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## Phase 2: Development of treatment method

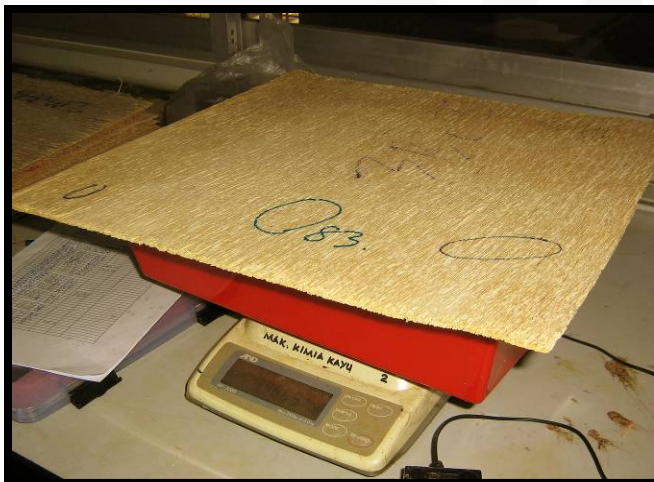
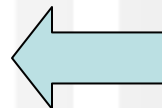
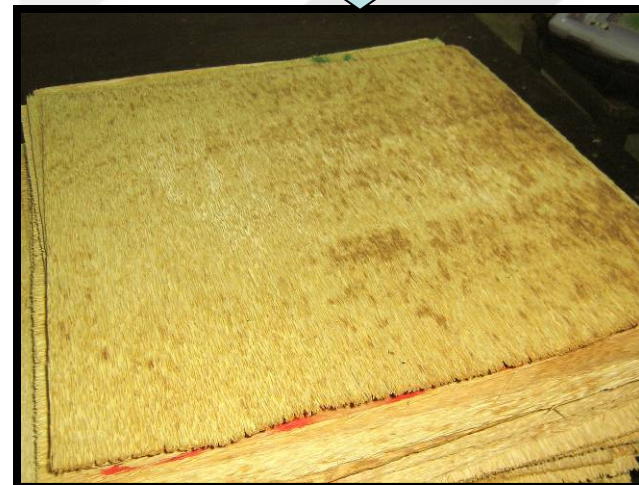
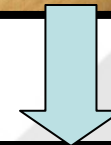
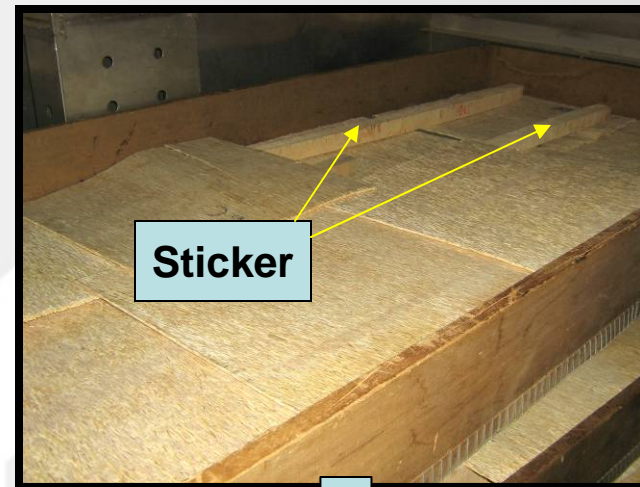
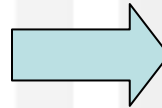
The optimum procedure for treating OPS veneers with LmwPF is as follows:

1. OPS veneers were segregated into outer and inner type
2. Dry the veneer to 6-8% MC
3. Soaking of veneers in LmwPF by passing the veneers through a container full with LmwPF resin for ~5seconds
4. Pre-pressing (between 2 rollers) to squeeze out the excessive resin. The pressure is set until “screw tight”. MC of treated veneers should be between 20-30%
5. Drying of phenolic treated veneers at 60° C for 48 hours. Final MC between 6-7%

# Phase 2: Treatment of Veneer



# Continue...



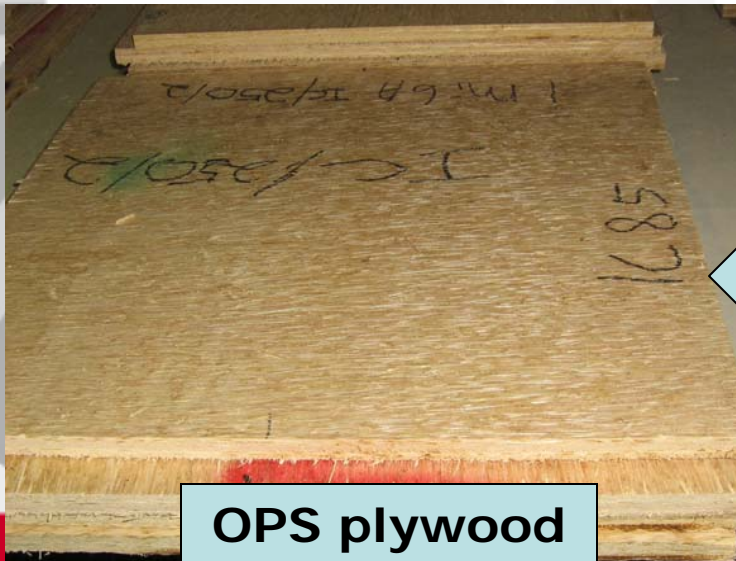
# Phase 3: OPS Plywood Manufactured



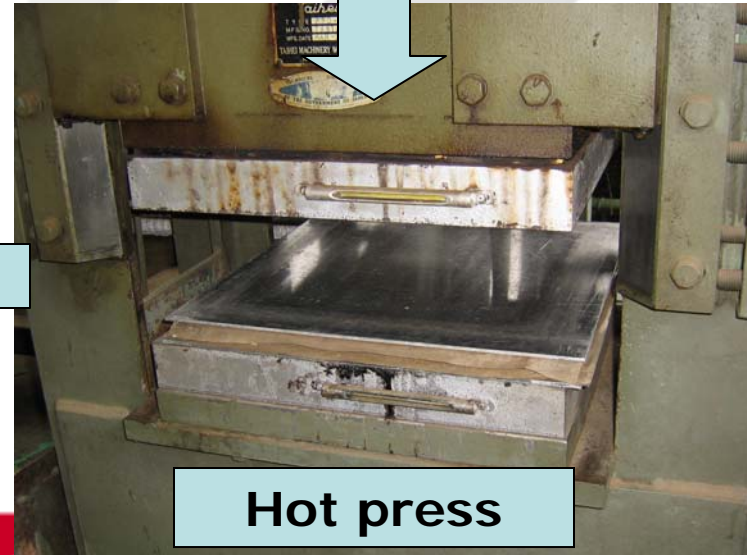
Glue spread



Cold press



OPS plywood



Hot press

# Properties Assessment

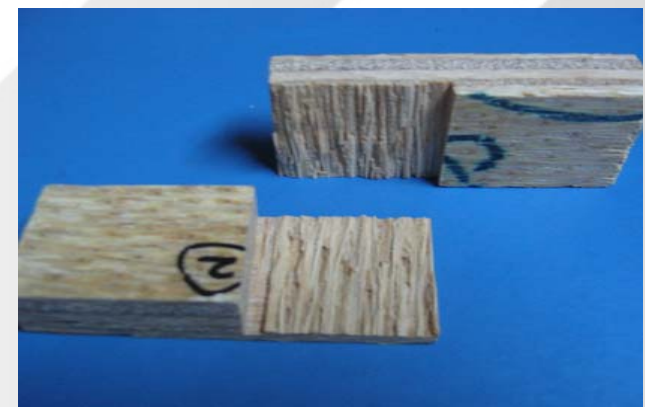


- Mechanical Test

## Static bending test BS EN 310



## Bonding test BS EN 314-1



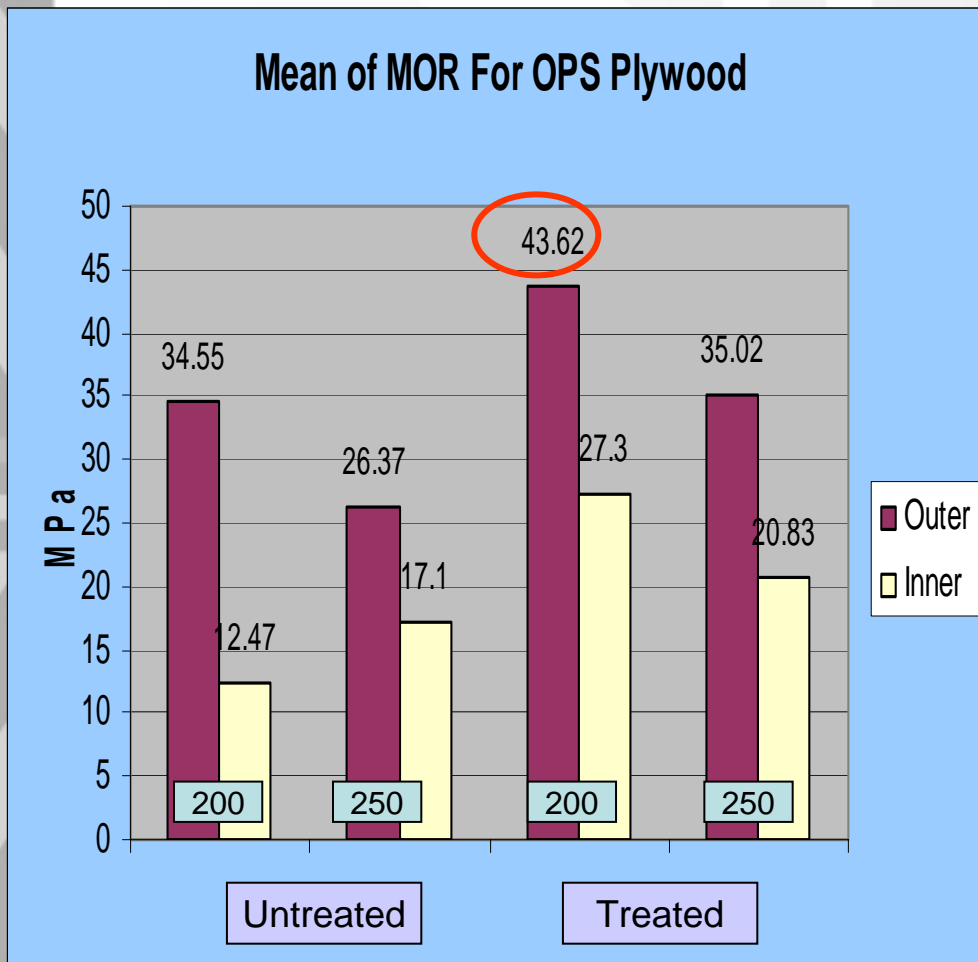




## Average Density Increment of OPT Veneer and Plywood after Treated with Lmw PF

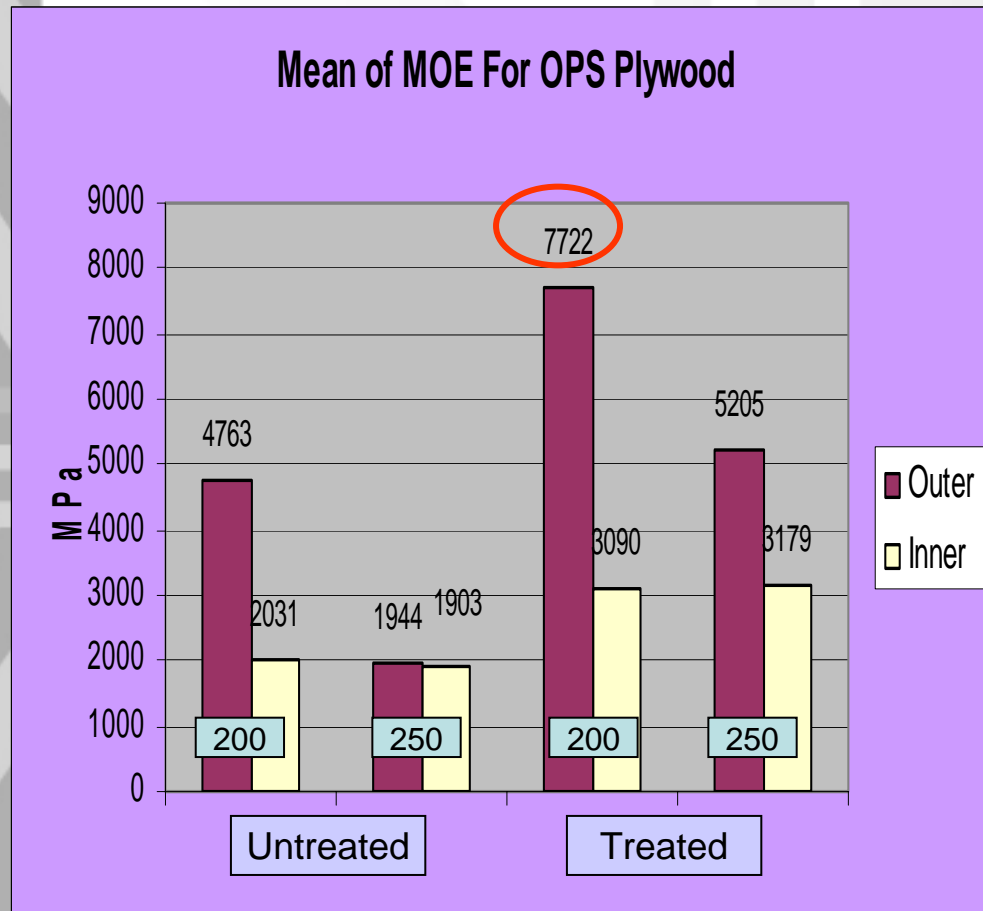
	Resin Solid Uptake (%)	Veneer Density (Kg/m <sup>3</sup> )		Increase in Veneer Density (%)	OPT Plywood (Kg/m <sup>3</sup> )		Increase in Plywood Density (%)
		Treated	Untreated		Treated	Untreated	
Outer	15.86	565	367	54	857	717	19
Inner	18.98	393	315	25	709	624	14

## Percentage of MOR increment



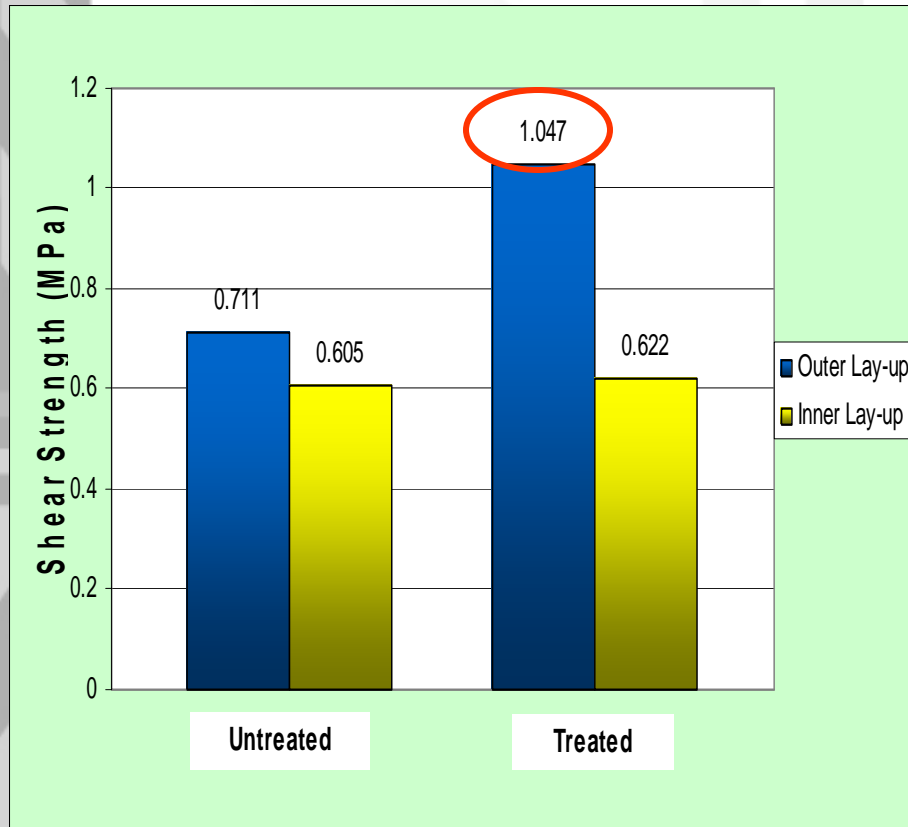
- Inner type gave high percentage of increment about 119% for 200g/m<sup>2</sup> glue spread rate.
- The lowest increment was 250g/m<sup>2</sup> glue spread rate with 22%.
- Shows that, treatment do help increase strength properties of OPS veneer and reduced the amount of resin consumption.

# Percentage of MOE increment

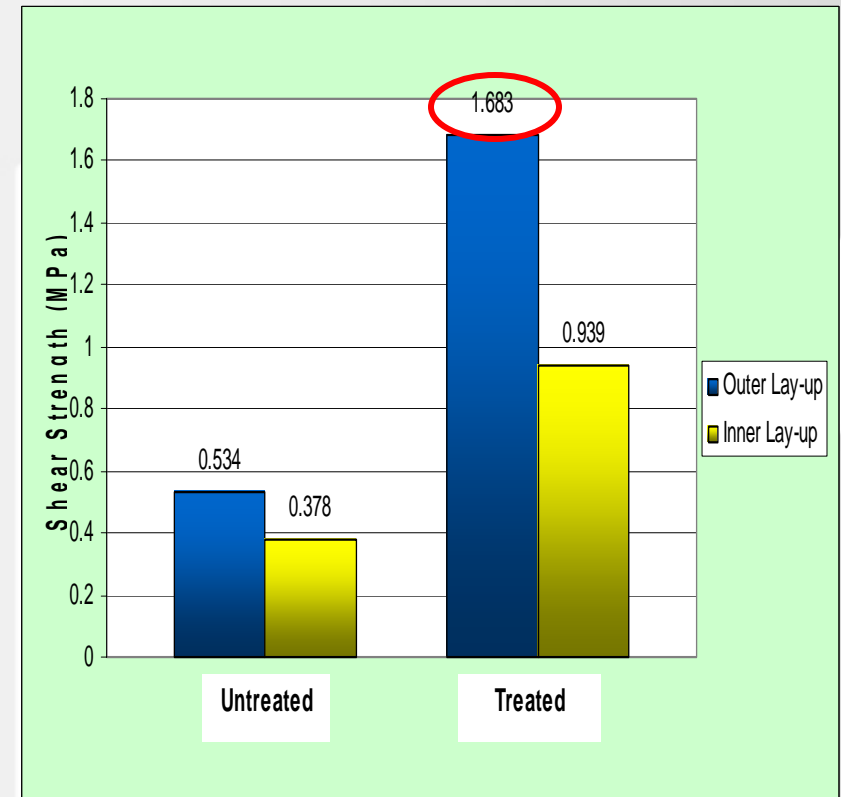


- The highest result for MOE increment is outer type with 250g/m<sup>2</sup> glue spread rate.
- Treating the veneer with LmwPF resin had increased the stiffness by **67%**
- The lowest increment was inner type with 200g/m<sup>2</sup> glue spread rate.
- Shows that treatment help to increase stiffness properties of the boards.

# Glue Bond Shear Strength of Phenolic-treated OPS Plywood in Dry Test and Wet Test (cold water)

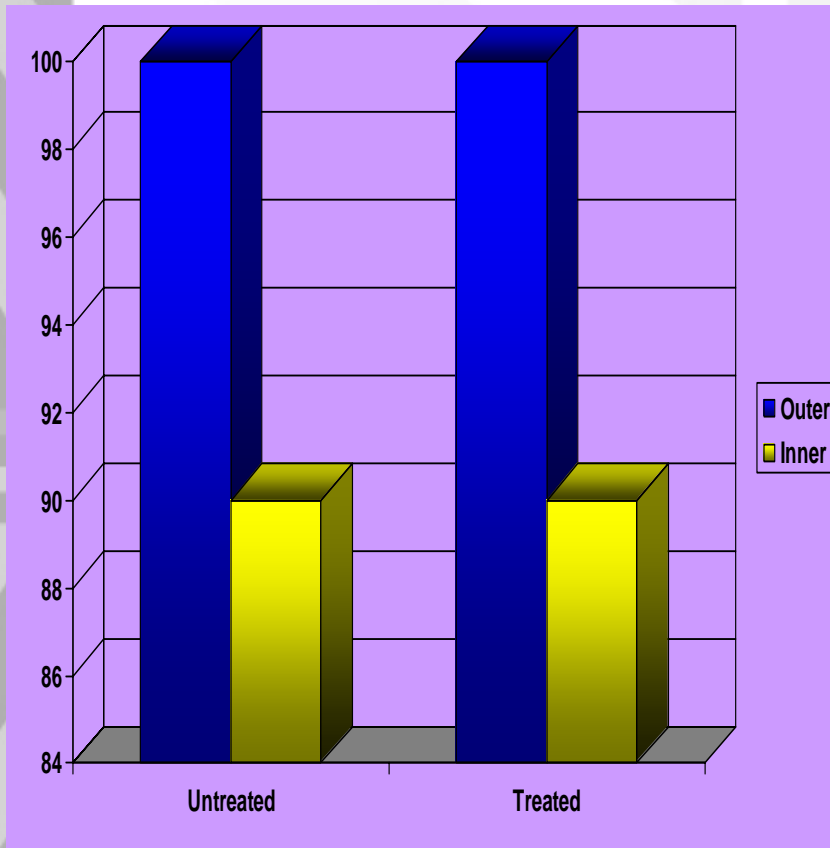


**Dry Test**

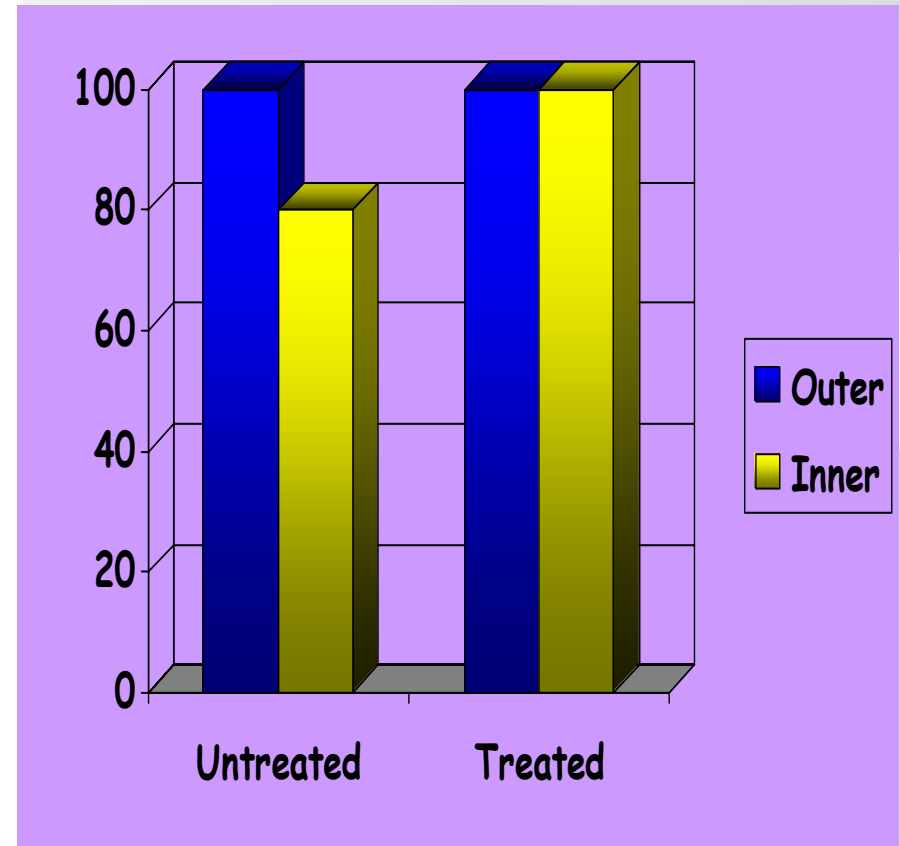


**Wet Test**

## Percentage of Wood Failure of Phenolic-treated OPS Plywood in Dry Test and Wet Test (cold water)



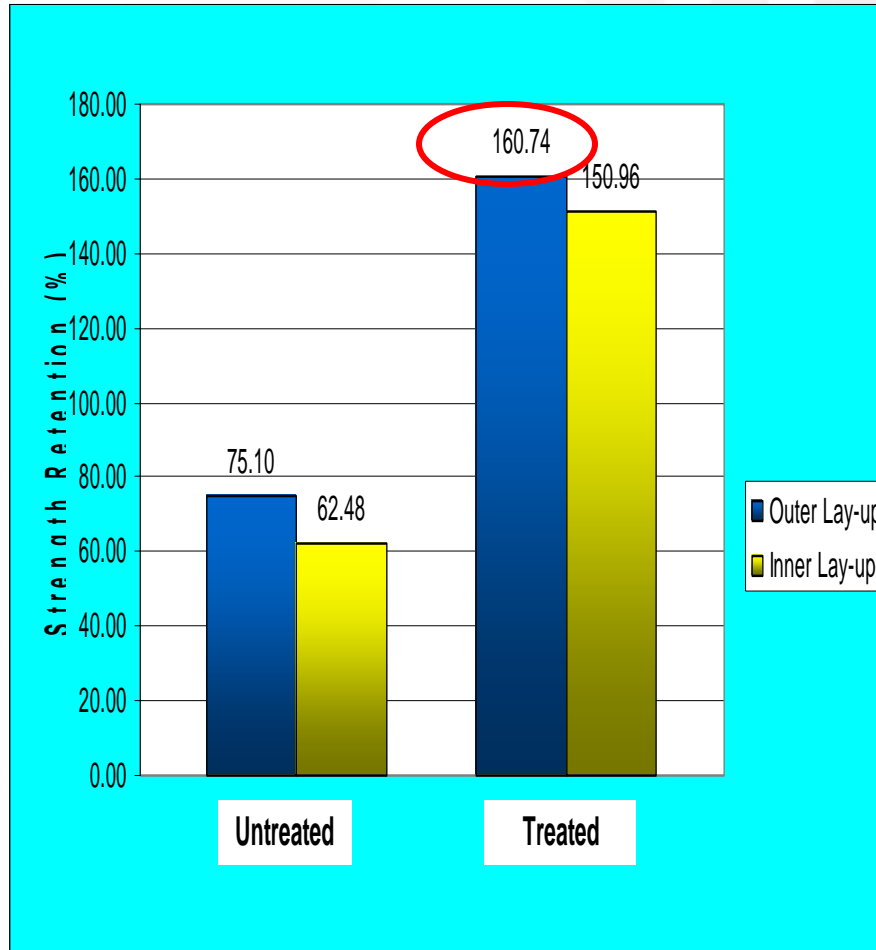
Dry Test



Wet Test



## Strength Retention of Phenolic-Treated OPS Plywood



- Further improvement of bond quality
- On going analysis is currently conducted to look at the cured glueline whether some crosslinking had occurred between Phenolic-treated veneer and UF resin.



# Conclusions

- **Treatment of OPS veneer with LmwPF has significantly improved the strength.**
- **Segregating the veneers by density (outer= 358 - 442kg/m<sup>3</sup> inner= 272 - 446kg/m<sup>3</sup> ) had increased the average strength of the OPS plywood.**
- **Greater improvement was seen in the performance of plywood made from the lower-density-inner veneers.**
- **The technique used in this study was able to enhance the strength and bond quality properties of plywood made from OPS veneer, as well as, reduced the amount of resin consumption.**



Thank You For Your Attention

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